

1        FRACTURE FIXATION PLATE WITH PARTICULAR PLATE HOLE AND  
2        FASTENER ENGAGEMENT AND METHODS OF USING THE SAME

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4        This application is a continuation-in-part of U.S. Serial No. 10/689,797, filed  
5        October 21, 2003, which is a continuation-in-part of U.S. Serial No. 10/664,371, filed  
6        September 17, 2003, which is a continuation-in-part of U.S. Serial No. 10/401,089, filed  
7        March 27, 2003, all of which are hereby incorporated by reference herein in their  
8        entireties.

9  
10                                      BACKGROUND OF THE INVENTION

11  
12        1. Field of the Invention

13                This invention relates broadly to surgical implants. More particularly, this  
14        invention relates to a bone fracture fixation system for distal radius fractures.

15  
16        2. State of the Art

17                Fracture to the metaphyseal portion of a long bone can be difficult to treat.  
18        Improper treatment can result in deformity and long-term discomfort.

19  
20                By way of example, a Colles' fracture is a fracture resulting from compressive  
21        forces being placed on the distal radius, and which causes backward or dorsal  
22        displacement of the distal fragment and radial deviation of the hand at the wrist. Often, a  
23        Colles' fracture will result in multiple bone fragments which are movable and out of

1 alignment relative to each other. If not properly treated, such fractures may result in  
2 permanent wrist deformity and limited articulation of the wrist. It is therefore important  
3 to align the fracture and fixate the bones relative to each other so that proper healing may  
4 occur.

5  
6 Alignment and fixation of a metaphyseal fracture (occurring at the extremity of a  
7 shaft of a long bone) are typically performed by one of several methods: casting, external  
8 fixation, interosseous wiring, and plating. Casting is non-invasive, but may not be able to  
9 maintain alignment of the fracture where many bone fragments exist. Therefore, as an  
10 alternative, external fixators may be used. External fixators utilize a method known as  
11 ligamentotaxis, which provides distraction forces across the joint and permits the fracture  
12 to be aligned based upon the tension placed on the surrounding ligaments. However,  
13 while external fixators can maintain the position of the wrist bones, it may nevertheless  
14 be difficult in certain fractures to first provide the bones in proper alignment. In addition,  
15 external fixators are often not suitable for fractures resulting in multiple bone fragments.  
16 Interosseous wiring is an invasive procedure whereby screws are positioned into the  
17 various fragments and the screws are then wired together as bracing. This is a difficult  
18 and time-consuming procedure. Moreover, unless the bracing is quite complex, the  
19 fracture may not be properly stabilized. Plating utilizes a stabilizing metal plate typically  
20 against the dorsal side of the bones, and a set of parallel pins extending from the plate  
21 into holes drilled in the bone fragments to provide stabilized fixation of the fragments.  
22 However, many currently available plate systems fail to provide desirable alignment and  
23 stabilization.

1

2           In particular, with a distal radius fracture the complex shape of the distal radius,  
3 including the bulky volar rim of the lunate fossa, relatively flat volar rim of the scaphoid  
4 fossa, and volar marginal fragment from the lunate fossa should be accommodated. A  
5 fixation plate should provide desirable alignment and stabilization of both the  
6 subchondral bone and the articular surfaces of the distal radius.

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## SUMMARY OF THE INVENTION

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10           It is therefore an object of the invention to provide an improved fixation system  
11 for distal radius fractures.

12

13           It is another object of the invention to provide a distal radius volar fixation system  
14 that desirably aligns and stabilizes multiple bone fragments in a fracture to permit proper  
15 healing.

16

17           It is also an object of the invention to provide a distal radius volar plate system  
18 which provides support for articular and subchondral surfaces.

19

20           It is an additional object of the invention to provide a distal radius volar plate  
21 system which accommodates the anatomical structure of the metaphysis of the distal  
22 radius.

23

1           It is a further object of the invention to provide a distal radius volar plate system  
2   which provides support without interfering with ligaments and soft tissues near the edge  
3   of the articular surface.

4  
5           In accord with these and other objects, which will be discussed in detail below, a  
6   distal radius volar fixation system is provided. The system generally includes a plate  
7   intended to be positioned against the volar side of the radius, a plurality of bone screws  
8   for securing the plate along a non-fractured portion of the radius bone, a plurality of bone  
9   pegs sized to extend from the plate and into bone fragments at the metaphysis of a radius  
10   bone, and one or more K-wires to facilitate alignment and fixation of the plate over the  
11   bone and guide the process of application. Preferred bone pegs and peg holes within the  
12   plate are provided which facilitate entry and retention of the bone pegs within the peg  
13   holes.

14  
15          The plate is generally T-shaped, defining an elongate body and a generally  
16   transverse head angled upward relative to the body, and includes a first side which is  
17   intended to contact the bone, and a second side opposite the first side. The body includes  
18   a plurality of countersunk screw holes for the extension of the bone screws therethrough,  
19   and optionally one or more substantially smaller alignment holes. The lower surfaces of  
20   the radial and ulnar side portions of the head are contoured upward (in a Z direction)  
21   relative to the remainder of the head to accommodate the lunate and scaphoid processes.  
22   An extension is provided at the head portion along the distal ulnar side of the head to  
23   buttress the volar lip (marginal fragment) of the lunate fossa of the radius bone, thereby

1 providing support to maintain the wrist within the articular socket. Moreover, the  
2 contoured shape provides a stable shape that prevents rocking of the plate on the bone.  
3 The upper and lower surfaces are chamfered to have a reduced profile that limits potential  
4 interface with the ligaments and soft tissue near the edge of the lunate fossa. The head  
5 includes a plurality of threaded peg holes for receiving the pegs therethrough. The peg  
6 holes are arranged into a first set provided in a proximal portion of the head, and a second  
7 relatively distal set preferably provided in the tapered portion of the head.

8  
9 The first set of the peg holes is substantially linearly arranged generally laterally  
10 across the head. The line of pegs is preferably slightly oblique relative to a longitudinal  
11 axis through the body of the plate. Axes through the first set of holes are preferably  
12 oblique relative to each other, and are preferably angled relative to each other in two  
13 dimensions such that pegs inserted therethrough are similarly obliquely angled relative to  
14 each other. The pegs in the first set of peg holes provide support for the dorsal aspect of  
15 the subchondral bone fragments.

16  
17 The second set of peg holes is provided relatively distal of the first set. The holes  
18 of the second set, if more than one are provided, are slightly out of alignment but  
19 generally linearly arranged. The pegs in the second set of peg holes provide support for  
20 the volar aspect of the subchondral bone, behind and substantially parallel to the articular  
21 bone surface.

1           A distal alignment hole is provided generally between two peg holes of the second  
2 set of peg holes. At the upper surface of the plate, the distal alignment hole is  
3 substantially cylindrical, while at the lower surface, the hole is laterally oblong. One or  
4 more proximal alignment holes of a size substantially smaller than the peg holes are  
5 provided substantially along a distal edge defined by a tangent line to shafts of pegs  
6 inserted in the first set of peg holes, and facilitate temporary fixation of the plate to the  
7 bone with K-wires. Furthermore, along the body two longitudinally displaced alignment  
8 holes are also provided. All of the alignment holes are sized to closely receive individual  
9 K-wires.

11           The plate may be used in at least two different manners. According to a first use,  
12 the surgeon reduces a fracture and aligns the plate thereover. The surgeon then drills K-  
13 wires through the proximal alignment holes to temporarily fix the orientation of the head  
14 of the plate to the distal fragment. Once the alignment is so fixed, the fracture is  
15 examined, e.g., under fluoroscopy, to determine whether the K-wires are properly aligned  
16 relative to the articular surface. As the axes of the proximal alignment holes correspond  
17 to axes of adjacent peg holes, the fluoroscopically viewed K-wires provide an indication  
18 as to whether the pegs will be properly oriented. If the placement is correct, the K-wires  
19 maintain the position of the plate over the fracture. The peg holes may then be drilled  
20 with confidence that their locations and orientations are proper. If placement is not  
21 optimal, the K-wires can be removed and the surgeon has an opportunity to relocate  
22 and/or reorient the K-wires and drill again. Since each K-wire is of relatively small

1 diameter, the bone is not significantly damaged by the drilling process and the surgeon is  
2 not committed to the initial drill location and/or orientation.

3

4 According to a second use, the plate may be used to correct a metaphyseal  
5 deformity (such as malformed fracture or congenital deformity). For such purposes, a K-  
6 wire is drilled into the bone parallel to the articular surface in the lateral view under  
7 fluoroscopy until one end of the K-wire is located within or through the bone and the  
8 other end is free. The free end of the K-wire is guided through the distal oblong  
9 alignment hole of the head of the plate, and the plate is slid down over the K-wire into  
10 position against the bone. The oblong alignment hole permits the plate to tilt laterally  
11 over the K-wire to sit flat on the bone, but does not permit movement of the plate over  
12 the K-wire in the anterior-posterior plane. The surgeon drills holes in the bone in  
13 alignment with the peg holes and then fixes the plate relative the bone with pegs. The  
14 bone is then cut, and the body of the plate is levered toward the shaft of the bone to re-  
15 orient the bone. The body of the plate is then fixed to the shaft to correct the anatomical  
16 defect.

17

18 Additional objects and advantages of the invention will become apparent to those  
19 skilled in the art upon reference to the detailed description taken in conjunction with the  
20 provided figures.

21

## BRIEF DESCRIPTION OF THE DRAWINGS

1

2

3           Fig. 1 is a radial side elevation of a right-hand volar plate according to the  
4 invention, shown with pegs coupled thereto;

5

6           Fig. 2 is an ulnar side elevation of a right-hand volar plate according to the  
7 invention, shown with pegs coupled thereto;

8

9           Fig. 3 is top view of a right-hand volar plate according to the invention, shown  
10 with pegs and screws;

11

12           Fig. 4 is bottom view of a right-hand volar plate according to the invention,  
13 shown with pegs coupled thereto;

14

15           Fig. 5 is a perspective view of a right-hand volar plate according to the invention,  
16 shown with pegs coupled thereto and K-wires extending through body and proximal head  
17 alignment holes;

18

19           Fig. 6 is a front end view of a right-hand volar plate according to the invention,  
20 shown with pegs coupled thereto and K-wires extending through alignment holes;

21

22           Figs. 7 through 12 illustrate a method of performing an osteotomy of the distal  
23 radius according to the invention;

1

2           Fig 13 is a side elevation of a partially threaded peg according to the invention;

3   and

4

5           Fig. 14 is a schematic illustration of a peg coupled within a peg hole according to

6   one embodiment of the invention.

7

8           **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

9

10           Turning now to Figs. 1 through 6, a fracture fixation system 100 according to the  
11   invention is shown. The system 100 is particularly adapted for aligning and stabilizing  
12   multiple bone fragments in a dorsally displaced distal radius fracture (or Colles' fracture).  
13   The system 100 generally includes a substantially rigid T-shaped plate 102, commonly  
14   called a volar plate, bone screws 104 (Fig. 3), pegs 106, 108, and K-wires 110 (Figs. 5  
15   and 6). Pegs 106 have a threaded head and a non-threaded shaft, and pegs 108 have both  
16   a threaded head and a threaded shaft. Either pegs 106 or 108, or a combination thereof  
17   may be used at the discretion of the surgeon. Exemplar pegs are described in more detail  
18   in U.S. Pat. No. 6,364,882, which is hereby incorporated by reference herein in its  
19   entirety.

20

21           In addition, a preferred partially threaded shaft peg 108 is shown best in Figs. 6  
22   and 13. Peg 108 includes a head portion 200 with preferably a single helical machine  
23   thread 202 of a first pitch and a shaft 204 portion having one or more threads 206 of a

1 larger second pitch. (The head portion of non-threaded shaft pegs 106 also preferably  
2 includes a single helical thread.) The threads 206 preferably extend along a distal portion  
3 208 of the shaft 204, and most preferably where such distal portion comprises  
4 approximately one-half the length of the shaft. Alternatively, or in addition, one or more  
5 pegs may be used where the threads extend along substantially the entirety, or the  
6 entirety, or the length of the shaft.

7  
8 The volar plate 102 shown in the figures is a right-hand plate intended to be  
9 positioned against the volar side of a fractured radius bone of the right arm. It is  
10 appreciated that a left-hand volar plate is substantially a mirror image of the plate shown  
11 and now described. The T-shaped plate 102 defines an elongate body 116, and a head  
12 118 angled upward (in the Z-direction) relative to the head. The angle  $\alpha$  between the  
13 head 118 and the body 116 is preferably approximately 25°. The head 118 includes a  
14 distal buttress 120 (i.e., the portion of the head distal a first set of peg holes 134,  
15 discussed below). The plate 102 has a thickness of preferably approximately 0.1 inch,  
16 and is preferably made from a titanium alloy, such as Ti-6Al-4V.

17  
18 Referring to Fig. 4, the body 116 includes four preferably countersunk screw  
19 holes 124, 125, 126, 127 for the extension of bone screws 104 therethrough (Fig. 2). One  
20 of the screw holes, 127, is preferably generally oval in shape permitting longitudinal  
21 movement of the plate 102 relative to the shaft of a bone screw when the screw is not  
22 tightly clamped against the plate.

Referring to Figs. 3 and 4, according to one preferred aspect of the plate 102, the head portion 118 includes a first set of threaded preferably cylindrical peg holes 134 (for placement of pegs 106 and/or 108 therein) and a second set of threaded preferably cylindrical peg holes 138 (for placement of pegs 106 and/or 108 therein). Referring to Fig. 14, the peg holes 134, 138 optionally have double lead internal threads 210, 212, with entries to these threads located 180° apart. Each of the threads 210, 212 is adapted to mate securely with the thread 202 on a peg head 200, however thread 202 can only mate with one of the threads 210, 212 at any one time. The depth of each of the double lead internal threads 210, 212 is preferably substantially less than the depth of thread 202 on peg head 200, and most preferably approximately one half such depth. The double lead threads 210, 212 facilitate alignment and entry of the peg head thread 202 into a thread of the peg hole, as the peg will require rotation by at most 180° in a single rotational direction before thread engagement. Furthermore, in distinction from a conical head and hole, the cylindrical double lead thread hole does not compromise the secure interlock attained from full travel of the thread 202 of the peg head 200 through the cylindrical peg hole 134, 138 through, e.g., 900°. Moreover, the double lead threads reduce cross-threading by fifty percent, whether a single lead thread or a double-lead thread peg is used.

Referring back to Figs. 3 and 4, the peg holes 134 of the first set are arranged substantially parallel to a line  $L_1$  that is preferably slightly skewed (e.g., by 5°-10°) relative to a perpendicular  $P$  to the axis  $A$  of the body portion 116. Axes through the first set of peg holes (indicated by the pegs 106 extending therethrough) are preferably

1 oblique relative to each other, and are preferably angled relative to each other in two  
2 dimensions, generally as described in commonly-owned U.S. Pat. No. 6,364,882, which  
3 is hereby incorporated by reference herein in its entirety. This orientation of the pegs  
4 operates to stabilize and secure the head 118 of the plate 102 on the bone even where  
5 such pegs 106 do not have threaded shafts.

6

7 The second set of peg holes 138 is provided relatively distal of the first set of peg  
8 holes 134 and is most preferably primarily located in the buttress 120. Each of the peg  
9 holes 138 preferably defines an axis that is oblique relative to the other of peg holes 136  
10 and 138. Thus, each and every peg 106, 108 when positioned within respective peg holes  
11 134, 138 defines a distinct axis relative to the other pegs. Moreover, the axes of the peg  
12 holes 138 are preferably oriented relative to the axes of peg holes 134 such that pegs 106,  
13 108 within peg holes 138 extend (or define axes which extend) between pegs (or axes  
14 thereof) within peg holes 134 in an interleaved manner.

15

16 Referring specifically to Figs. 1, 2, 5 and 6, according to another preferred aspect  
17 of the plate 102, in order to approximate the anatomy for ideal fracture support and  
18 maintain a low profile, the upper and lower surfaces 140, 142, respectively of the buttress  
19 120 are chamfered, with the chamfer of the lower surface 142 being contoured for the  
20 anatomical structure that it will overlie. In particular, the lower surface 142 at an ulnar-  
21 side portion 144 of the head portion 118 is elevated primarily in a distal direction to  
22 accommodate the bulky volar rim of the lunate fossa, and the lower surface 142 at a  
23 radial side portion 146 of the head 118 is elevated laterally relative to the remainder of

1 the head to accommodate a prominence at the radial aspect of the bone, as indicated by  
2 the visibility of these lower surfaces in the side views of Figs. 1 and 2 and head-on view  
3 of Fig. 6. The contoured shape (with generally three defined planes) provides a stable  
4 shape that prevents rocking of the plate on the bone. In addition, the upper and lower  
5 surfaces 140, 142 are chamfered to have a reduced profile that limits potential interface  
6 with the ligaments and soft tissue (e.g., tendons) near the edge of the articular surface. A  
7 distal extension 148 is also provided at the ulnar side portion 146 to further buttress the  
8 volar lip (volar marginal fragment of the lunate fossa) of the articular socket of the radius  
9 bone, thereby providing support to maintain the wrist within the articular socket.

10  
11 Referring specifically to Figs. 3 and 4, according to a further preferred aspect of  
12 the invention, the plate 102 is provided with body alignment holes 150, proximal head  
13 alignment holes 152a, 152b, 152c (generally 152), and a distal head alignment hole 154,  
14 each sized to closely accept standard Kirschner wires (K-wires), e.g., 0.7 – 1.2 mm in  
15 diameter. The upper openings of all the alignment holes 150, 152, 154 are substantially  
16 smaller in diameter (e.g., by thirty to fifty percent) than the shafts of screws 104  
17 (approximately 3.15 mm in diameter) and the shafts of pegs 106, 108 (approximately  
18 2.25 mm in diameter). The body alignment holes 150 are longitudinally displaced along  
19 the body portion 116 and provided at an oblique angle (preferably approximately 70°, as  
20 shown in Fig. 5) relative to the lower surface 158 of the body portion 116. The proximal  
21 head alignment holes 152 alternate with the peg holes 134. A tangent line H to the  
22 distalmost points of the head alignment holes 152 is preferably substantially coincident or  
23 closely parallel with a line tangent to points on the circumferences of the shafts of pegs

1 106 inserted through holes 134 adjacent the head portion 118 of the plate 102. With  
2 respect to the proximal head alignment holes, it is appreciated that a shaft 106a of a peg is  
3 generally smaller in diameter than a head 106b of a peg (Fig. 6). Thus, a line tangent to  
4 the peg holes 134 (each sized for receiving the head 106b of peg 106) will be closely  
5 located, but parallel, to a line tangent to a distalmost point on the respective alignment  
6 hole 152. Nevertheless, for purposes of the claims, both (i) a tangent line which is  
7 preferably substantially coincident with a line tangent to points on the circumferences of  
8 the shafts of pegs and (ii) a tangent line to a set of peg holes shall be considered to be  
9 “substantially coincident” with a line tangent to a distalmost point of an alignment hole  
10 152. Axes through alignment holes 152 preferably generally approximate (within, e.g.,  
11 3°) the angle of an axis of an adjacent peg hole 134. Moreover, the axis through each  
12 proximal alignment hole 152 is preferably oriented substantially equidistantly between  
13 the axes through peg holes 134 on either side of the alignment hole. As such, K-wires  
14 110 inserted into the proximal alignment holes 152 (and extending coaxial with the axes  
15 therethrough) define a virtual surface which is substantially the same virtual surface  
16 defined by pegs 106, 108 inserted through peg holes 134. This common virtual surface  
17 follows the dorsal aspect of the subchondral bone. Thus, as described in more detail  
18 below, the insertion of K-wires 110 through proximal alignment holes 152 provides a  
19 visual cue to the surgeon regarding the alignment of the plate 102 and subsequently  
20 inserted pegs 106, 108. Distal head alignment hole 154 is provided between the central  
21 and radial-side peg holes 138, and has a circular upper opening, and a laterally oblong  
22 lower opening, as shown best in Fig. 6.

23

1           The plate may be used in at least two different applications: fracture fixation and  
2 correction of a metaphyseal deformity. In either application, an incision is first made  
3 over the distal radius, and the pronator quadratus is reflected from its radial insertion  
4 exposing the entire distal radius ulnarly to the distal radioulnar joint. For fracture  
5 fixation, the surgeon reduces the fracture and aligns the plate 102 thereover. The surgeon  
6 then drills preferably two K-wires 110 through respective body alignment holes 150, and  
7 preferably a plurality of K-wires through selected proximal head alignment holes 152 at  
8 the location at which the surgeon believes the pegs 106, 108 should be placed based on  
9 anatomical landmarks and/or fluoroscopic guidance. The K-wires temporarily fix the  
10 orientation of the plate to the distal fragment. While the fixation is temporary, it is  
11 relatively secure in view of the fact that the body alignment holes 150, proximal head  
12 alignment holes 152, and K-wires 110 therethrough are angled in different orientations  
13 relative to the lower surface of the plate. Once the alignment is so fixed, the fracture is  
14 examined, e.g., under fluoroscopy, to determine whether the K-wires 110 are properly  
15 aligned relative to the articular surface. As the axes of the proximal head alignment holes  
16 152 correspond to axes of the adjacent peg holes 134, the fluoroscopically viewed K-  
17 wires 110 provide an indication as to whether the pegs 106, 108 will be properly oriented.  
18 If the placement is correct, the K-wires 110 maintain the position of the plate 102 over  
19 the fracture while holes in the bone are drilled through the screw holes 124, 125, 126, 127  
20 for the screws 104 and peg holes 134, 138 for pegs 106, 108, with confidence that the  
21 locations and orientation of the screws and pegs inserted therein are anatomically  
22 appropriate. In addition, where pegs 108 are used, due to the difference in pitch between  
23 the head threads 202 and shaft threads 206, slight compression of a distally or dorsally

1 displaced fragment toward a proximal fragment or bone (e.g., 1.5 mm of travel) is  
2 effected even though the head 200 will lock relative to the head 118 of the plate 100.  
3 Once the screws 104 and pegs 106, 108 have secured the plate to the bone, the K-wires  
4 are preferably removed.

5  
6 If fluoroscopic examination indicates that placement of the K-wires 110 is not  
7 optimal, the K-wires can be removed and the surgeon has an opportunity to relocate  
8 and/or reorient the K-wires and drill again. Since each K-wire is of relatively small  
9 diameter, the bone is not significantly damaged by the drilling process and the surgeon is  
10 not committed to the initial drill location and/or orientation.

11  
12 The pegs 106 within peg holes 138 define projections that provide support at the  
13 volar aspect behind the articular surface of the bone surface. The sets of pegs 106, 108  
14 through peg holes 134, 138 laterally overlap so that the pegs preferably laterally alternate  
15 to provide closely-spaced tangential cradling of the subchondral bone. A preferred  
16 degree of subchondral support is provided with four peg holes 134 (and associated pegs)  
17 through the proximal portion of the head 118 of the plate, and three peg holes 138 (and  
18 associated pegs) through the distal portion of the head 118. The fracture fixation system  
19 thereby defines a framework which substantially tangentially supports the bone fragments  
20 in their proper orientation. In accord with an alternate less preferred embodiment,  
21 suitable support may also be provided where the pegs 106 and 108 are parallel to each  
22 other or in another relative orientation or with fewer peg holes and/or pegs.

23

1       The method particularly facilitates stabilization of a metaphyseal fracture which  
2   may include a smaller distal bone fragment spaced apart from a larger proximal fragment.  
3   The insertion of one or more threaded pegs 108 (preferably in conjunction with several  
4   non-threaded pegs 106) in which the threads on the shaft 206 have a pitch greater than the  
5   threads 202 on the head 200 causes a limited amount of compression of the smaller distal  
6   bone fragment toward the larger proximal bone fragment, and thus toward the plate.

7  
8       According to a second use, the plate may be used to correct a metaphyseal  
9   deformity 200 (such as malformed fracture or congenital deformity), as shown in Fig. 7.  
10   For such purposes, a K-wire 110 is drilled into the bone parallel to the articular surface S  
11   in the lateral view under fluoroscopy (Fig. 8). The free end of the K-wire 110 is guided  
12   through the oblong distal head alignment hole 154, and the plate 102 is slid down over  
13   the K-wire into position against the bone (Fig. 9). The oblong alignment hole 154  
14   permits the plate 102 to tilt laterally over the K-wire 110 to sit flat on the bone, but does  
15   not permit tilting of plate relative to the K-wire in the anterior-posterior plane. Once the  
16   plate 102 is seated against the bone, the surgeon drills holes in the bone in alignment with  
17   the peg holes 134, 138 (Fig. 3) and then fixes the plate relative the bone with pegs 106,  
18   108 (Fig. 10). The K-wire 110 is removed. The bone is then saw cut at 202 proximal the  
19   location of the head 118 of the plate 102 (Fig. 11), and the body 116 of the plate is  
20   levered toward the proximal diaphyseal bone 204, creating an open wedge 206 at the  
21   deformity (Fig. 12). When the body 116 of the plate 102 is in contact and longitudinal  
22   alignment with the diaphysis of the bone, the bone distal of the cut has been repositioned  
23   into the anatomically correct orientation relative to the shaft of the bone. The body 116

1 of the plate 102 is then secured to the bone with screws 104. Post-operatively, the open  
2 wedge in the bone heals resulting in an anatomically correct distal radius.

3  
4 While fixed single-angle pegs have been disclosed for use with the plate (i.e., the  
5 pegs may be fixed in respective threaded peg holes 134, 136 only coaxial with an axis  
6 defined by the respective peg holes), it is appreciated that an articulating peg system,  
7 such as that disclosed in co-owned U.S. Pat. No. 6,440,135 or co-owned and co-pending  
8 U.S. Serial No. 10/159,612, both of which are hereby incorporated by reference herein in  
9 their entireties, may also be used. In such articulating peg systems, the peg holes and  
10 pegs are structurally adapted such that individual pegs may be fixed at any angle within a  
11 range of angles. In addition, while less preferable, one or both sets of the pegs may be  
12 replaced by preferably blunt tines which are integrated into the plate such that the plate  
13 and tines are unitary in construct. Similarly, other elongate projections may be coupled  
14 to the plate to define the desired support.

15  
16 There have been described and illustrated herein embodiments of a fixation plate,  
17 and particularly plates for fixation of distal radius fractures, as well as a method of  
18 aligning and stabilizing a distal radius fracture and performing an osteotomy. While  
19 particular embodiments of the invention have been described, it is not intended that the  
20 invention be limited thereto, as it is intended that the invention be as broad in scope as the  
21 art will allow and that the specification be read likewise. Thus, while particular  
22 materials, dimensions, and relative angles for particular elements of the system have been  
23 disclosed, it will be appreciated that other materials, dimensions, and relative angles may

1 be used as well. In addition, while a particular number of screw holes in the volar plate  
2 and bone screws have been described, it will be understood another number of screw  
3 holes and screws may be provided. Further, fewer screws than the number of screw holes  
4 may be used to secure to the plate to the bone. Also, fewer or more peg holes and bone  
5 pegs may be used, preferably such that at least two pegs angled in two dimensions  
6 relative to each other are provided. In addition, while a particular preferred angle  
7 between the head and body has been disclosed, other angles can also be used. Moreover,  
8 while the cylindrical double lead thread hole and single thread head interface has been  
9 disclosed with respect to a fracture plate for distal radius fractures, it is appreciated that  
10 such a system has advantage to other orthopedic stabilization devices such as fragment  
11 plates (which may be rectangular in shape or a different shape) and plates specifically  
12 designed for fractures of other bones. Similarly, a threaded peg (i.e., locking screw) with  
13 threads of different pitches on the head and along the shaft may also be used in other  
14 applications. Furthermore, while a double lead thread hole is preferred for use with a peg  
15 having a single thread on its head, it is appreciated that, e.g., a triple lead thread hole can  
16 be used where the entry leads are angularly offset by 120°. Such will reduce cross  
17 threading by two-thirds, but will also reduce hole thread depth further. Also, while the  
18 double lead thread system is described with respect to a bone plate, it is appreciated that  
19 it can be applied to other orthopedic implants, such as rods, nails, prostheses, etc., having  
20 holes for fixation. Furthermore, while the double lead thread hole has been shown in  
21 conjunction with a peg having a single lead thread on its head portion, it is appreciated  
22 that the double lead thread hole is perfectly adapted for use with a peg having a double  
23 lead thread on its head portion. It will therefore be appreciated by those skilled in the art

- 1 that yet other modifications could be made to the provided invention without deviating
- 2 from its spirit and scope.